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Series 6000 Low Cost Core Storage Unit
Modular Power System

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1. GENERAL DESCRIPTION

1.1 SCOPE

This document specifies the Series 6000 Low Cost Core Storage Unit Power System. The CSU consists of either 2, 4, 6 or 8 magnetics modules, a core controller, operator panel, portable exerciser, care package (bringing in the a-c power), harnesses and regulators with interconnecting wiring. The CSU power system is primarily the regulators with interconnecting wiring. The other elements of the CSU are considered as designed and specified separately. The input power, signal interfaces, output requirements, life, reliability and environmental conditions imposed on the CSU power system comprise this specification.

1.2 APPLICABLE DOCUMENTS

Low Cost Core Memory 32K x 37	4WMM8035AA4
Low Cost Core Memory 64K x 37	4WMM8036AA4
Low Cost Core Memory 96K x 37	4WMM8043AA4
Low Cost Core Memory 128K x 37	4WMM8044AA4
EPS -- 655 Core Storage Unit	43A219603
EPS -- 655 Maintainability Design	43A219617
EPS -- 655 System	43A219600
EPS -- 655/355 General Design Requirements	43A177851
Frame Assembly	43E220134G3
Care Package	43D232735
Control Panel	43C228273
Schematic Diagram-Control Panel	43D222301
Schematic Diagram-Care Package	43D233089
Temperature Programming Network	43C243176G1
Panel Marking	43D232345

2. INPUT POWER

2.1 LINE VARIATIONS-OPERATING

The input power to the CSU power system shall conform to EPS 43A177851, paragraph 4.0.

2.2 POWER OUTAGE

The CSU power system shall operate, with all regulator output voltages remaining in confidence (see paragraph 4.3.1) with an a-c input transient defined as an output voltage reduction of 2.5 percent and a frequency reduction to 50 hertz lasting 20 seconds or less. This transient is imposed in addition to the 120 volt ±5 percent line to neutral range defined in EPS 43A177851.

2.3 LINE BALANCE

The combined a-c steady state load presented by the CSU shall be balanced within 10 percent or 1 ampere, whichever is greater. This requirement is imposed on the CSU power system as well.

2.4 POWER FACTOR

The CSU power system shall present a steady state load to the motor-generator which has a power factor of 0.80 or greater.

3. INPUT AND OUTPUT CIRCUITS

3.1 POWER-ON/OFF INTERFACE INFORMATION

3.1.1 Input Circuit Breaker - Care Package

The power-on circuits can be activated if power is available to the CSU and the a-c input circuit breaker is closed. When the a-c circuit breaker is closed the control panel "AC Breaker On" lamps light. Opening the a-c breaker will remove all power from the CSU.

3.1.2 Power-On Switch - Cabinet Operator Panel

Activation of the Power-On Switch will result in a-c 3-phase 5-wire power being available to the CSU power system and magnetics module(s) fans.

3.1.3 Power-Off Switch - Cabinet Operator Panel

Activating this switch will remove a-c power from the CSU power system and magnetics module(s) fans.

3.1.4 Remote Control from Series 6000 System to Care Package

Remote power-on and off control capability shall be provided and function like 3.1.2 and 3.1.3 above.

3.2 REGULATED D-C OUTPUT SEQUENCING AND CONTROL

3.2.1 Low Voltage D-C Sequence (On)

The +5 volt supply for core controller and magnetics module logic shall be turned on first. The -5 volts, and +3 volts reference voltage shall be available in any order, but after the +5 volts above.

3.2.2 Low Voltage Confidence (Level 1 Confidence)

After all the low voltage supplies are available and within voltage limits a low voltage confidence signal shall be sent to the core controller. Confidence shall be indicated by a logic "0" and lack of confidence will be a logic "1."

3.2.3 High Voltage Enable

After the receipt of low voltage confidence the core controller shall provide two high voltage enable outputs to cause the high voltage regulators to be turned on. A logic "0" shall allow the regulators to turn on and a logic "1" or an open circuit shall turn them off. (For 32 and 64K configurations.)

3.2.4 High Voltage Confidence (Level 2 Confidence)

When the high voltage regulators are up to voltage and within voltage limits, a high voltage confidence line shall be sent to the core controller. Confidence is a logic "0" and lack of confidence shall be a logic "1."

3.2.5 Turn Off Sequence

At least one high voltage regulator output (Word or Bit), per Section 7, must be +7 volts or less before the +5 volts regulator voltage is below +3.2 volts.

The following reasons will result in complete shutdown of all regulators. See 3.2.8 for additional details.

1. Removal or complete loss of input power (ac).

2. Temperature shutdown.

3. An out of confidence of any low voltage regulator.

4. Loss of any phase of input power.

5. Any regulator fault.

Removal of high voltage enable will cause the high voltage regulators to shutdown. The Word and Bit regulators shall have crowbar circuits to speed removal of voltages. The low voltage regulators may be left on during "decay rate" condition or means shall be provided for turning the low voltage regulators on with the high voltage regulators disabled.

The high voltages shall not start to crowbar down before 100 microseconds after indication of 1 through 4 above.

A voltage regulator failure may result in immediate shutdown without the 100 microsecond requirement.

3.2.6 Local Control and Status Indication

In addition to the automatic sequencing described above, each output shall be protected by means of appropriately rated circuit protective devices to protect against overcurrent and overvoltage. Operation of the circuit protective devices shall result in loss of confidence from the regulator.

Each regulator output shall be monitored and visual indication of regulator operation shall be provided. Either confidence or lack of confidence indication shall be provided.

3.2.7 Power Turn On and Failure

In the event of a-c power turn on, power failure, or CSU System turn off the supplies shall conform to the following:

Turn On

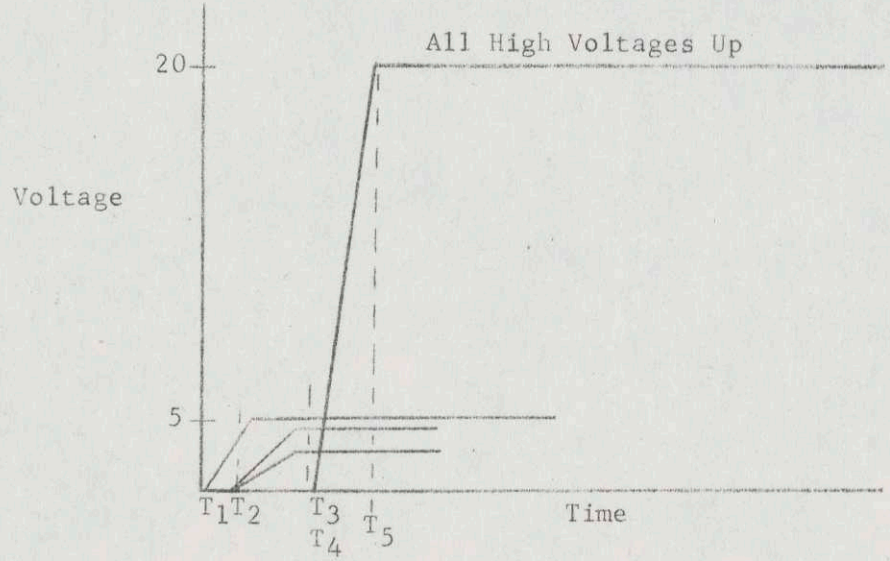
T_1 = Power Turn On

T_2 = +5 Volts Confident

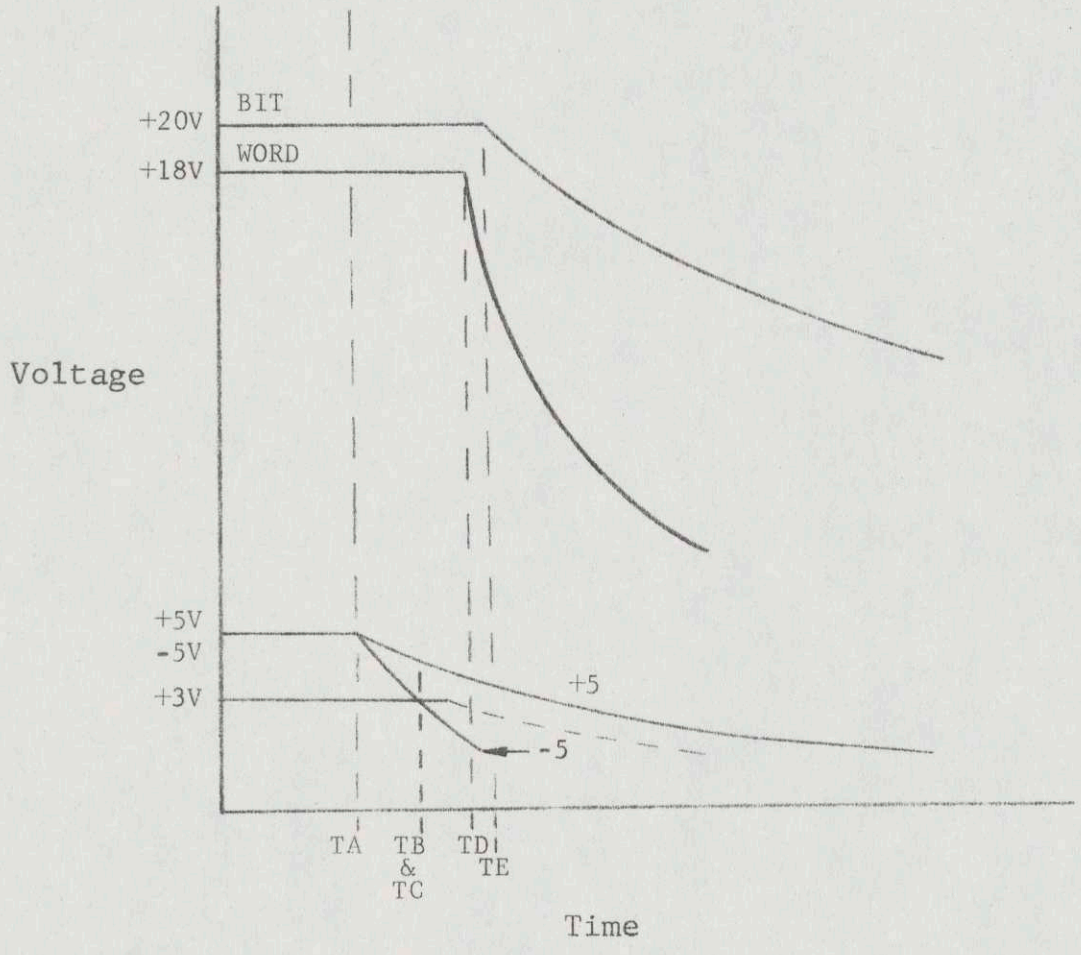
T_3 = +3 Volts and -5 Volts Confident; not coincidently (Level 1 Confidence)

T_4 = High Voltage Enable

T_5 = High Voltages Confident (not coincidently) (Level 2 Confidence)



Turn Off



T_A = Power Turn Off or Power Failure

T_B = Loss of Level 1 Confidence

T_C = Loss of High Voltage Enable

T_D = High Voltage Crowbar Start

T_E = Loss of Level 2 Confidence

Loss of Level 1 Confidence shall take place because the +5 volts regulator has reached its undervoltage point (-10 percent), or because of any Level 1 regulator fault condition.

Loss of Level 2 Confidence shall take place because the Word regulator has reached their undervoltage point (-10 percent), or because of any regulator fault condition. The Word regulator will have a nominal RC Time Constant of 6 milliseconds or less on crowbar.

3.3 TEMPERATURE ALARM

There shall be provision for accepting up to four normally closed thermal alarm inputs from the magnetcis modules (one per module) as well as at least one thermal alarm from the power supply. These inputs shall be monitored at all times and when "normal" or "alarm" conditions exist shall provide outputs as follows:

	Normal	Alarm
To Care Package	Open Contacts (isolated)	Closed Contacts
Monitor Lights	No Lights	Light for Modules at Alarm (one for each magnetics module located at the power supply)

The Care Package circuit is isolated from frame ground.

The Care Package will provide for overtemperature contacts to light lights in the operator panel and for remote alarm indication.

An audible thermal alarm shall be provided on the Care Package and an alarm reset will be provided on the operator panel (and at a remote point) to disable the sounder. An alarm reset light shall be provided on the operator panel.

3.4 TEMPERATURE SHUTDOWN

[B] There shall be provision for accepting, up to eight normally closed thermal shutdown inputs from the magnetics modules (one per module) as well as at least one thermal shutdown from each package of the power supply. These inputs shall be monitored at all times and an open circuit in any magnetics module shall result in the memory system being shutdown.

A thermal shutdown will be accomplished by closing a normally open contact circuit in the CSU power system. This circuit closure will be tied to the Care Package overtemperature (Level 2) shutdown circuit.

3.5 REMOTE VOLTAGE MARGINS

The memory power supply system will have remote control of the voltage margin switching functions as follows:

3.5.1 Voltage Margin Function

Bit 1	Bit 2	Voltage State
0	0	Normal
0	1	+5 Percent
1	0	-5 Percent
1	1	Illegal Condition

Logic "0" is approximately zero volts.
Logic "1" is approximately +5 volts.

3.5.2 Voltages to be Margin Switched (2 Lines per Voltage)

Margin Data Bit	P00 Pin Number (CC)	Function	Bit
54	01	High Voltage	1
55	03	High Voltage	2
64	21	+5 volt	1
65	23	+5 volt	2

Even pins 02-28 are all d-c return pins in P00.

3.5.3 Conditions

Each core controller controlled voltage shall be capable of being independently controlled from normal to +5 percent or -5 percent from core controller inputs.

3.6 TEMPERATURE COMPENSATION

3.6.1 Regulator Voltage Compensation

Each word and bit regulator output shall be independently temperature programmable over a magnetic module temperature range of 14 degrees Centigrade to 54 degrees Centigrade. The output voltage shall change at a rate of 0.40 volt (at nominal) increase for every 10 degrees Centigrade decrease in temperature. The four word (or bit) outputs from the magnetics modules will be combined at the regulator and one composite signal used for compensation.

3.6.2 Temperature Programming Network

The temperature programming network is defined by drawing 43C243176G1.

3.7 OTHER CONTROL CIRCUITS

3.7.1 Metering

There shall be an ammeter and a voltmeter provided for monitoring of current and voltage for each of the following supply outputs:

Low Voltage	High Voltage
V_R (+3V) voltage only	
+5 volt	18 volt word
-5 volt	20 volt bit

Each independent output shall be monitored.

An OFF position on the monitoring circuits is optional. The meters shall be +5 percent accuracy or better and located at the power supplies. A minimum of 1 ammeter and 1 voltmeter shall be provided.

4. REGULATED POWER OUTPUT REQUIREMENTS

4.1 OUTPUT VOLTAGES AND LOADS

4.1.1 Regulator Requirements - Low Voltage

	+5V	-5V	+3V Reg.
Output Voltage Normal	+5V	-5V	+3V
Output Current Design Minimum	150A	5.0A	1.0A
Adjustment Range (Minimum)	±5%	±5%	2V to 4V
Margin Percent of Set Value	±5%	±5%**	---
D-C Load Regulation 0 to 100 Percent Load	±1%	±1%	±1%
Total Tolerance 1000 hours, Load Regulation, Temperature, Line & Load Variations	±2%	±2%	±2%
Transients No Load to Full Load Step Change	±5%***	±5%	±5%
Ripple*	$50mv_{pp}$	$50mv_{pp}$	$50mv_{pp}$
Spikes on Ripple*	$300mv_{p}$	$300mv_{p}$	$300mv_{p}$

*At constant rated current
**Local only - margin together.
***Transient 10 amp step change.

4.1.2 Regulator Requirements-High Voltage (For Eight Magnetics Modules) +20V Bit 1, +18V Word 1

	Bit 1	Word 1
Output Voltage Nominal	20	18
Output Current Design Minimum	25	4
Adjustment Range Minimum	15-26V	15-26V
Margin Percent of Set Value	±5%	±5%
D-C Load Regulation 0 to 100 Percent Load	±1%	±1%
Total Tolerance 1000 hours, Load Regulation, Temperature, Line & Load Variations	±2%	±2%
Transients No Load to Full Load Step Change	±5%	±5%
Ripple*	$250mv_{pp}$	$250mv_{pp}$
Spikes on Ripple*	$300\ mv_{p}$	$300mv_{p}$

*At constant rated current

4.2 OVERVOLTAGE PROTECTION

4.2.1 Overvoltage Warning and Shutdown

Voltage	Core Controller Warning	Maximum Shutdown Voltage
+5V Logic	Yes	+6.5V
+5V Sense	Yes	+6.5V
+3V Reference	No	+5.5V (maximum - no shutdown)
-5V	Yes	-6.5V
+20V Bit	Yes	+29.0V
+18V Word	Yes	+29.0V

The warning is a lack of the confidence signal (+10 percent of nominal).

+3V Reference is derived from +5V supply.

4.3 UNDERVOLTAGE PROTECTION

All voltages require undervoltage protection except +3 volts reference.

4.3.1 Undervoltage Warning and Shutdown

Voltage	Core Controller Warning	Minimum Shutdown Voltage
+5V Logic	Yes	+4.2V
+5V Sense	Yes	+4.2V
+3V Reference	No	None
-5V	Yes	-4.2V
+20V Bit	Yes	+12V
+18V Word	Yes	+12V

The warning is the lack of a confidence signal (-10 percent of nominal).

4.4 OVERCURRENT PROTECTION

All output voltage supplies shall have overcurrent protection as follows:

Each supply shall be essentially constant voltages from 0 percent load to 100 percent load. At approximately 110 to 150 percent of rated load the supply shall limit on current and fail on undervoltage, or equivalent action.

4.5 MARGINS

Each voltage that has margins per Section 4.1.1 and 4.1.2 will have provision for local margin switching located in the power supply as follows, per regulator.

+5 Percent ±0.5 Percent
Normal
-5 Percent ±0.5 Percent

Local margin switching shall take precedence over remote voltage margin controls.

5. ENVIRONMENT

The environment requirements are the same as 43A177851.

6. MAINTAINABILITY

6.1 GENERAL

The elements of the power system shall be designed to facilitate maintenance and ease of access to terminal boards, printed wiring boards, adjustments and controls.

6.2 MEAN TIME BETWEEN FAILURE

The design goal MTBF for each regulator output voltage shall be 200,000 hours or greater.

The CSU power system design goal MTBF shall be 25,000 hours or greater for the 128K configuration, in 1972.

6.3 EQUIPMENT LIFE

The equipment shall have a normal service life of not less than 10 years, with only normal maintenance performed at the computer installation.

6.4 MEAN TIME TO REPAIR

A design goal for 1972 is 0.5 hours mean time to repair with 95% of the repairs being completed in 2.8 hours or less.

7. PHYSICAL SIZE

The power supply subsystem shall be compatible with the Series 6000 system frame and chassis space allocation per drawings 43D232345 and 43E220134G3.

8. PREREQUISITES

Prerequisites are the applicable document, Section 1.2 of this document and EPS 43A177851.

ISSUED BY: Ike Ross 10 July 1971
Date

APPROVED BY: C P Shea April 7, 1972
Date

REVIEWED BY: R C Clay 4-19-71
Date

Date

Date

Date

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